REMARKS

The Office Action dated June 29, 1994 and the references cited therein have been carefully considered. The amendments to the specification and claims have been made to correct errors in the originally filed application. In the Office Action, Claims 1-30 were rejected under 35 U.S.C. §103 as being unpatentable over U.S. Patent 4,435,838 to Gourlay in view of U.S. Patent 5,012,499 to Vali, et al.

In the Office Action, the Examiner contends that the Gourlay reference teaches a method and apparatus for imaging including a coded mask 11, a position sensitive detection array 10 that receives the coded optical input and generates a coded electric signal to be later decoded by decoder 18 and viewed on display 19. The Examiner notes that the Gourlay reference fails to teach a separate position sensitive detector to provide a coded optical signal to a charge coupled device (CCD) array which in turn would generate a coded electrical signal to be processed and displayed. The Examiner contends that the Vali, et al. reference discloses a gamma ray detecting device using a scintillation crystal in concert with a charge coupled device (Claim 2) for imaging. It is the Examiner's contention that it would have been an obvious design modification to form the Gourlay detector 10 from a scintillator and a CCD or possibly semiconductor photodiodes such that the scintillator produces a coded optical signal and the CCD receives the coded optical signal and produces a coded electrical signal therefrom.

The Examiner further contends that the use of wave guides, optical fibers or tapers as well as many other optical equivalents would have been obvious to use to prevent loss of

optical data. Additionally, the Examiner contends that the choice of the scintillator being a plurality of glass fibers and using a form of absorber is well within the skill level in the art as being functional equivalents and an obvious variation which was deemed not to be novel. Finally, the Examiner notes that neither the Gourlay reference nor the Vali, et al. reference teaches the use of a uniformly redundant array coded mask or that the cross-sectional area of the coded mask be approximately two times the cross-sectional area of the position sensitive detector to provide for a maximum field of view ranging from about 1 degree to about 45 degrees. Notwithstanding the lack of teaching in the prior art, the Examiner contends that these limitations are a mere obvious design choice and are not novel.

The Gourlay reference discloses a method and apparatus for tomographically imaging different selected planes of a three-dimensional object by detecting radiation through a coded aperture mask, storing an image of the radiation detected over a period of time, and decoding each selected object plane by a correlation process appropriate to the size of the shadow of the mask cast on the detector by points in the selected object plane. The Gourlay reference discloses that the mask 11 is parallel to the detection surface 12 and is controllably movable towards and away from the detection surface through the use of guide means. The tomographical imaging can be achieved by changing distances "D" (the distance from the detector to the source) and "d" (the distance from the mask to the source) and thus keeping the ratio D/d constant thereby minimizing the processing power required in the decoding circuitry since a fixed decoding process may be used rather than a different decoding process for each selected object plane.

The Gourlay reference further discloses that the detector 10 is an Anger camera, which detects photons emitted from an object which pass through transparent portions of the coded mask 11. A conventional Anger camera is disclosed in U.S. Patent 4,209,780 to Fenimore, et al.

An Anger camera, as disclosed in Fenimore, et al., detects emitted photons from a gamma source and produces an X and Y position for the detected location of the emitted photons. The X and Y signal is converted to a digital position by an A to D convertor. The digital signal is then applied to a dual parameter pulse height analyzer which increments the appropriate memory location. In this manner, the image projected on the detector is stored for subsequent processing. Once all of the data has been recorded in memory the device includes a means to reconstruct an image of the emitting source on a display.

The present invention as defined in the claims provides for an improved gamma imaging camera over a conventional Anger camera. The claimed construction of the gamma imaging camera of the present invention includes a coded mask for generating a coded shadow of received gamma rays, a position sensitive detector which generates a coded optical signal in response to a coded shadow impinging thereon, and an array of charged coupled devices which are responsive to the coded optical signal and generate a coded electrical signal in response thereto. The system of the present invention further includes a signal processor for decoding the coded electrical signal and generating an image signal for display thereof. In an alternative embodiment, an array of semiconductor gamma ray detectors or semiconductor photodiodes generate the coded electrical signal. The claimed gamma ray imaging system also includes a high

sensitivity two-dimensional optical signal detector comprising an image intensifier and a CCD imaging sensor with optical fiber couplers. The combination of these devices increases optical efficiency thereby making the system of the present invention more efficient and sensitive than conventional Anger cameras.

The Gourlay reference does not teach or suggest the claimed gamma ray imaging system comprising the combination of a coded mask, a position sensitive detector, an array of charged coupled devices and a signal processor, as specifically defined in Claims 1, 17, and 19. The Gourlay reference also does not teach or suggest a gamma ray imaging system using an array of semiconductor gamma ray detectors or semiconductor photodiodes to generate the coded electrical signal as defined in independent Claims 23 and 24. Furthermore, there is no teaching or suggestion in the Gourlay reference to include an image intensifier interposed between the position sensitive detector and the array of charged coupled devices for amplifying and intensifying the coded optical signal generated by the position sensitive detector to thereby increase sensitivity of the system, as specifically defined in Claim 7.

The Vali, et al. is directed to a gamma ray detecting device using dislocation-free crystal. The Vali, et al. reference is designed to operate using the Bormann effect, which is the anomalous transmission of gamma rays or x-rays through a dislocation-free single crystal incident at the Bragg angle. Changing of the relative angle of the detector changes the Bragg angle with respect to the source and provides means for detecting different wave length gamma rays emitted from a source. Consequently, scanning or rotating the crystal with respect to an extended source produces a gamma ray spectrum. The Vali, et al.

reference further discloses that the detector includes a dislocation-free single crystal surrounded by a gamma ray shield. Positioned adjacent to a transmission surface of the dislocation-free crystal is a gamma ray detector, disclosed as typically comprising a scintillation counter, for example, and may be a lithium doped germanium detector or the like. The Examiner notes that Claim 2 of the Vali, et al. reference defines the gamma ray detector means as comprising a gamma ray detecting charge coupled device. However, such a gamma ray detecting charge coupled device is not disclosed in the specification and, it is Applicants' understanding that no such gamma ray detecting charge coupled device is presently available or has been developed.

The present invention as defined in independent Claims 1, 17, 19, 23 and 24 provides for a relatively simple, yet highly effective design for a gamma ray imaging system. Claims 1, 17 and 19 define that the gamma ray imaging system includes a position sensitive detector to generate a coded optical signal from a received coded shadow formed by a coded mask and an array of charge coupled devices responsive to the coded optical signal to generate a coded electrical signal therefrom. This coded electrical signal is ultimately decoded and can be displayed on any suitable display means. Furthermore, Claims 23 and 24 define that the electrical signal is generated by an array of semiconductor gamma ray detectors or semiconductor photodiodes. The Vali, et al. reference does not teach or suggest the detector of the claimed gamma ray imaging system which includes, at a minimum, a position sensitive detector and an array of charged coupled devices or, in alternative embodiments, an array of gamma ray detectors or semiconductor photodiodes. Furthermore, as defined in Claim 7, the gamma ray imaging system of the present invention further includes an image intensifier interposed

between the position sensitive detector and the array of charge coupled devices for amplifying and intensifying the coded optical signal to thereby increase sensitivity of the system. The Vali, et al. reference does not teach or suggest such a structure.

Moreover, the position sensitive detector is further defined in Claims 10-14 to be either a glass scintillator formed from a plurality of glass fibers wherein the glass fibers include an external mural absorber coating to minimize cross-talk between the fibers, a plastic fiber scintillator or a crystal scintillator. Neither the Gourlay reference nor the Vali, et al. reference, separately or in combination, teaches or suggests the use of a position sensitive detector as defined in dependent Claims 10-14 in combination with an array of charge coupled devices and the coded mask to form a detector for gamma ray imaging system.

The Examiner's contention that the claimed present invention including a position sensitive detector and an array of charge coupled devices would have been an obvious design modification is totally unsupported by any of the references of record. Neither the Gourlay nor the Vali, et al. reference nor any other reference noted by the Examiner teaches or suggests the claimed structure of the present invention. Furthermore, the claimed combination including an image intensifier and/or optical tapers was also deemed obvious by the Examiner. Once again this contention is wholly unsupported by the references of record.

Since each of Claims 2-16, 18, 20-22 and 25-30, depend upon and thus recite each of the limitations of one of the independent Claims 1, 17, 19, 23 and 24, these claims also patentably

distinguish over the references of record for the same reasons set forth above.

The gamma ray imaging system of the present invention provides numerous advantageous features over conventional gamma ray detectors, including conventional Anger cameras. The gamma ray imaging system of the present invention is compact and portable, provides a large field of view, includes a zooming capability without loss of resolution for detailed mapping, provides for high sensitivity over a wide dynamic range and provides a real-time image.

In view of the foregoing amendments and remarks, Applicants respectfully request favorable reconsideration of Claims 1-30 and allowance of the application with Claims 1-30.

Applicants also note that a Supplemental Information Disclosure Statement is being concurrently submitted herewith along with the required fee.

Respectfully submitted,

Glenn T. Henneberger

Glenn T. Henneberger
Registration No.: 36,074
Attorney for Applicants

HOFFMANN & BARON
350 Jericho Turnpike
Jericho, New York 11753
(516) 822-3550
GTH/da